

## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>5</sup> :</b>  <b>H01R 17/12, 9/05</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 93/10579</b>  <b>(43) International Publication Date:</b> 27 May 1993 (27.05.93)
<p><b>(21) International Application Number:</b> PCT/GB92/02103</p> <p><b>(22) International Filing Date:</b> 13 November 1992 (13.11.92)</p> <p><b>(30) Priority data:</b>          P 41 37 477.0      14 November 1991 (14.11.91) DE          G 92 03 261.3 U    11 March 1992 (11.03.92) DE</p> <p><b>(71) Applicant (for MG only):</b> RAYCHEM LIMITED [GB/GB];          Roll House, 7 Rolls Buildings, London EC4A 1NH (GB).</p> <p><b>(71) Applicant (for all designated States except MG US):</b> WALTER ROSE GMBH &amp; CO. KG [DE/DE]; Profilstrasse 6-8, D-5800 Hagen 1 (DE).</p> <p><b>(72) Inventors; and</b>  <b>(75) Inventors/Applicants (for US only):</b> MARTIN, Horst [DE/DE]; Friedenseiche 18, D-5860 Iserlohn (DE). KOHLHAAS, Martin [DE/DE]; Im Rohlande 55, D-5840 Schwerte 4 (DE).</p>		<p><b>(74) Agents:</b> AUCKLAND-COOKE, Jacqueline et al.; Raychem Limited, Faraday Road, Dorcan, Swindon, Wiltshire SN3 5HH (GB).</p> <p><b>(81) Designated States:</b> MG, UA, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, SE).</p> <p><b>Published</b>  <i>With international search report.</i></p>
<p><b>(54) Title:</b> COAXIAL CABLE PLUG/COUPLING</p> <div data-bbox="516 1297 1156 1633" data-label="Image"> </div> <p><b>(57) Abstract</b></p> <p>A coaxial cable plug or a coaxial coupling comprising an outer conductor contact element (7), an insulating body (8) for supporting the pin (9) or socket of the plug or coupling, or for supporting directly the inner conductor (3) of the coaxial cable (2), and a contacting cutting cylinder (12) for penetrating the coaxial cable (2) to contact the outer conductor (5) thereof. The outer conductor contact element (7), the insulating body (8) and the pin (9) or socket (if present) of the plug or coupling are fixedly connected to each other at the factory for ease of handling by the end user. The outer conductor contact element (7) and the contacting cutting cylinder (12) are supplied as separate parts.</p>		

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Coaxial Cable Plug/Coupling

This invention relates to a coaxial cable plug, or a coaxial cable coupling. In particular it relates to such a plug or coupling comprising (1) an insulating body for supporting directly the inner conductor of the coaxial cable or for supporting a contact pin (in the case of a coaxial cable plug) or a contact socket (in the case of a coaxial cable coupling), containing a blind bore for receiving the inner conductor of the coaxial cable, (2) an outer conductor contact element and (3) a contacting cutting cylinder which is positioned, in use, in electrical contact with the outer conductor contact element and with the outer conductor of the coaxial cable.

As used herein the term contacting cutting cylinder means a contacting cylinder that makes contact (with the outer conductor of the coaxial cable) by cutting into the coaxial cable, e.g. by penetrating between the outer conductor and the dielectric of the coaxial cable.

DE-3141966-A1 discloses a connection device for coaxial cables and a two-way coupling of similar construction. It describes an outer conductor contact element, that is in the form of a contact cylinder for contacting the outer conductor of the coaxial cable, the contact cylinder penetrating, in the coupling position, between the dielectric and the outer conductor of the coaxial cable. This known solution has the advantage that faulty connections, and in particular short-circuits between the outer and inner conductors of the coaxial cable are substantially avoided. The danger of such a short circuit is particularly high when the outer conductor of the coaxial cable is in the form of a braid, since in such a case there is a significant danger that, with improper connection, a bridge may be formed between the outer conductor and the inner conductor of the coaxial cable by that outer conductor braid.

However, notwithstanding its advantages, a considerable drawback of the known solution, described in DE-3141966, resides in the fact that the construction is of a very complicated kind with very many individual parts, locking tapers,

screw sockets, union nuts, sealing rings and so on. These have to be laboriously assembled by the user and the mounting of the device on the coaxial cable is therefore quite complicated.

A connection for a coaxial cable that is of a similarly complicated construction is disclosed in DE-4100600-A1. This describes a connection for coaxial cables in which both the inner and the outer conductor are formed from a stranded conductor or a plurality of fine wires. In this known solution, an inner contact in the form of a sharp spike is pushed into the wire braid of the inner conductor whilst substantially simultaneously a cylinder constructed as a cutting element pushes itself underneath the outer conductor braid. Additional wedge element and coupling rings are provided for fixing and strain relief, and an additional spike screw is provided for contacting the outer conductor. This solution too is complicated in construction. While such a so-called Cinch (RCA) plug may be useful in certain applications, for example in the cabling of high-rated devices for entertainment electronics, It is not possible to use such a connection for example for coaxial cables having single-core comparatively rigid, inner conductors.

A number of coaxial cable plug variants are known from WO-90/15454, which similarly have the advantage of contacting of the outer conductor, but which are again comparatively complicated in construction. In the embodiment of WO-90/15454 the inner conductor of the coaxial cable itself forms the contact pin of the coupling in the mounted position. This is different from many other known solutions in which the inner conductor of the coaxial cable enters a contact socket of the coaxial cable plug or coupling, which a socket is provided with its own plug pin with a blind bore for receipt of the inner conductor of the coaxial cable.

Similarly DE-U-7137878 describes an arrangement in which the coupling itself provides a plug pin.

DE-U-7123952 describes a coaxial cable plug comprising a metal housing piece which as an integral piece forms the outer conductor contact from the coaxial cable to the plug, and comprises a tubular portion that penetrates beneath

the outer conductor of the coaxial cable. The metal housing piece supports an insulating region and a central contact pin for receiving the coaxial cable inner conductor.

The problem of the invention is to obtain the advantages of a simplified construction of a cable plug similar to that described in DE-U-7123952, but to allow the customer the flexibility of choosing a coaxial cable plug or coupling (socket) with minimum inventory. The problem is also to facilitate mounting thereof, and especially to optimise the number of individual components, which will be of benefit to the economic manufacture of a coaxial cable plug or coupling.

Thus, the invention provides a device that is a coaxial cable plug, or a coaxial cable coupling comprising:

- (a) an outer conductor contact element for providing an electrical contact for the plug or coupling from the outer conductor of a coaxial cable;
- (b) an insulating body fixedly connected at the factory with the outer conductor contact element without the use of screw threads, the insulating body, in use, supporting the inner conductor of the coaxial cable, and/or being provided with a contact pin (in the case of a coaxial cable plug) or a contact socket (in the case of a coaxial cable coupling) provided with a contact blind bore for receiving the inner conductor of the coaxial cable; the contact pin or socket, if present, also being connected at the factory with the outer conductor contact element and the insulating body, without the use of screw threads; and
- (c) a contacting cutting cylinder which is a separate piece from the outer conductor or contact element, but which can be positioned, in use, in electrical contact with the outer conductor contact element, the outer conductor contact element itself being positioned, in use, on the outer or inner surface of the outer conductor of the coaxial cable.

The fixedly connected parts may be referred to as an integral formation, i.e. they form a single unit.

As a result of the fact that the outer conductor contact element is constructed at the factory fixedly connected with (1) an inner insulating body, and (2), where present, a contact pin located therein (in the case of a coaxial cable plug) or a contact socket (in the case of a coaxial cable coupling), the device is easier for the end user or consumer to handle, compared to the complex parts described in some of the prior art mentioned above.

Also a significant advantage is provided over DE-U-7123952 in providing the contacting cutting cylinder and outer conductor contact element as separate parts, since it allows the customer the chance to select either a plug (to form a plug) or a socket (to form a coupling) outer contact element piece, in combination with the contacting cutting cylinder. This reduces stock requirements. Where we say the outer conductor contact element and the contacting cutting cylinder are separate parts, we mean they are supplied to the customer as separate parts. They are, of course, fitted together, in use, by the customer or installer.

Since the fixedly connected parts are connected to one another without screw threads, not only assembly at the factory, but also handling by the end user is simple.

Preferably the contacting cutting cylinder is also connected to the outer conductor contact element without using screw threads, in order to be able, as a general principle, to avoid screw connections entirely.

According to the invention, various arrangements are envisaged to connect electrically the outer conductor contact element and the contacting cutting cylinder of the device of the present invention. For example the contacting cutting cylinder may be arranged to grip over at least regions of the outer conductor contact element.

The contacting cutting cylinder is preferably arranged to penetrate beneath the outer conductor of the coaxial cable between the outer conductor and the dielectric. Instead it may be positioned outside the outer conductor e.g.

between the cable insulating jacket, which usually surrounds a coaxial cable, and the outer conductor.

Preferably the device also comprises a further sleeve positioned, in use, over the outer conductor contact element and the contacting cutting cylinder. Preferably the sleeve is slip-on. Preferably it is provided with catches for a snap-in or clamping connection to the outer conductor contact element and/or the contacting cutting cylinder. This allows the sleeve to form or enhance a firm connection between those parts, and also provides environmental protection. Also the sleeve may be in frictional or form-fitting engagement with the outer conductor contact element and also press into the outer surface of the coaxial cable insulation (for example by means of clamping catches). In this way the sleeve can also provide strain relief.

In the preferred embodiment, where the device comprises a contact pin or socket with a blind bore for receiving the coaxial cable inner conductor, this blind bore is preferably provided with an additional inner conductor gripping contact member. This measure may enhance the connection to the inner conductor and may also provide strain relief for that connection. In one embodiment the region of the inner conduct gripping contact member, may be arranged to project beyond the opening receiving end of the blind bore. This is advantageous as it allows direct connection to the inner conductors of coaxial cables that have not been stepped or not fully stepped at their free ends, and which present a straight flat end to be contacted. This projecting inner conductor gripping contact member in the device means that the inner conductor of the coaxial cable comes into electrical contact with the contact pin of the plug or the socket of the device of the invention.

Although certain elements of the invention are fixedly connected together at the factory, other elements may be connected together in a non-permanent fashion, e.g. by screwing them together. This may be done by the end user. For example the contacting cutting cylinder and the outer conductor contact element may be respectively provided with internally and externally threaded regions for screw connection together. Similarly a snap-in connection or the like may be provided between those parts.

Also, the contacting cutting cylinder may similarly be provided with an external or internal cutting thread for connection to the outer conductor of the coaxial cable. The thread will be external or internal depending on whether the contacting cutting cylinder is beneath or above the outer conductor of the coaxial cable. The expression "external or internal cutting thread" includes also external and internal claws or similar configurations.

Similarly, regions of the outer surfaces of the elements to be connected to each other by the consumer can be equipped with a corrugation or a friction-increasing shape or, alternatively, with spanner-application faces to facilitate handling by the consumer.

Embodiments of the invention are now described in detail by way of example only, with references to the accompanying drawings, in which

Figure 1 shows, in section, an assembled plug according to the invention placed on the end of a coaxial cable;

Figure 2 shows, in section, a slip-on sleeve which is part of the plug of Figure 1;

Figure 3a shows, in section, a coaxial cable plug pin, which is part of the plug of Figure 1 with further components pre-installed at the factory;

Figure 3b shows, in section, a coaxial cable coupling with further elements pre-installed at the factory;

Figure 4 shows, in section, a contacting cutting cylinder which is part of the plug of Figure 1;

Figure 5 shows, in the same view as Figure 1, a coaxial cable plug according to another embodiment of the invention; and



Figure 6 to 9 show modified illustrative embodiments of coaxial cable plugs/couplings.

The device shown in Figure 1 and generally designated 1 is a coaxial cable plug which is placed on a coaxial cable generally designated 2. In conventional manner, the coaxial cable 2 consists, from the inside outward, of an inner conductor 3, a dielectric 4, an outer conductor 5 and an outer insulation 6.

In the example shown in Figure 1, the coaxial cable plug 1 is constructed and supplied to the consumer in three individual elements. These three individual elements are shown in Figures 2, 3a and 4.

A first of these elements is shown in Figure 1 and 3a. It comprises an outer conductor contact element 7, fixedly connected at the factory with an inner insulating body 8 and a contact pin 9, which is supported in the inner insulating body 8. The contact pin 9 is equipped with a blind bore 10 for receiving the inner conductor 3 of the coaxial cable 2. In the example shown, the blind bore 10 of the contact pin 9 is additionally provided with an inner conductor gripping contact member 11. This contact member 11 grips the inner conductor 3 of the coaxial cable 2 when the conductor 3 is pushed in. It ensures a good contact with the pin 9, and at the same time provides a certain degree of strain relief. The outer conductor contact element 7 is also provided with a shoulder 7a for cooperating with a second of the three individual elements supplied to the consumer. This is described below. The parts mentioned above making up the first of the three elements supplied to the consumer are shown together in Figure 3a. They form a unit that is pre-assembled at the factory.

A second of the three elements supplied to the consumer is shown in Figure 1 and Figure 4. This is for directly contacting the outer conductor 5 of the coaxial cable 2. It comprises a contact/cutting cylinder referenced 12. The contacting cutting cylinder 12 comprises a conductive portion 12a, which is wedge-shaped in cross-section and provided with friction-increasing outward projections. The wedge shaped portion 12a of the contacting cutting cylinder 12 is able to penetrate between the inner surface of the outer conductor 5 and the outer surface of the dielectric 4 of the coaxial cable 1, as will be seen in Figure 1.

The contacting cutting cylinder 12 is also provided with a cylindrical section of larger diameter than the wedge shaped portion. This larger diameter region contains one or more longitudinal slits, and by means of the slit portion of larger diameter, designated 12b in Figure 4, the contacting cutting cylinder 12 is able to grip over the shoulder 7a of the outer conductor contact element 7 mentioned above. This is also apparent from Figure 1.

Finally, the third individual element supplied to the consumer is shown in Figure 2. This has the function of pressing the elements against one another in the mounted position. It comprises a slip-on sleeve 13 which lies (as shown in Figure 1) with one clamping face 13a in clamping/frictional engagement externally on the region 12b of the contact/cutting cylinder 12 whereby it presses the latter inward. The slip-on sleeve is also provided at its edge, which in use is furthest from the coaxial cable, with clamping projections 13b. These can engage a corresponding groove (not shown) in the shoulder 7a of the outer conductor contact element. In order to be able to grip the outer insulation 6 of the coaxial cable 2, catch or clamping projections 13c can additionally be provided at the edge of the clamping sleeve 13 which is nearest to the coaxial cable in use.

Mounting of the constituent elements of the plug 1 is carried out as follows: first, the slip-on sleeve 13 is pushed over the coaxial cable 2 (the free end of the coaxial cable being stepped in the manner shown in Figure 1, i.e. the inner conductor 3 projecting beyond the free end of the coaxial cable by a pre-determined amount). Then, the contacting cutting cylinder 12 is pushed onto the free end of the coaxial cable 2 in such a manner that it pushes itself between the outer surface of the dielectric 4 and the inner surface of the outer conductor 5 while slightly expanding the latter, as will be seen from Figure 1. Next, the outer conductor contact element 7 together with the inner insulating body 8 and the contact pin 9 fastened therein is pushed on, with the result that the inner conductor 3 pushes itself into the inner conductor gripping contact member 11 and is gripped in the blind bore 10. Subsequently, the slip-on sleeve 13 is pushed over the outer conductor contact element 7 and snaps onto the shoulder 7a of element 7. Once the elements have been snapped or clamped together, mounting is complete.

Figure 3b shows a cylindrical outer conductor contact element 7' that can be gripped over the outer conductor contact element 7 and the contact pin 9 to convert the coaxial cable plug to a coaxial cable coupling. The surface of the cylindrical element 7' is of slit construction and, instead of the contact pin 9, a contact socket 9' is provided, likewise having a blind bore 10' and an additional inner conductor gripping contact member 11' located in the blind bore 10'. In all other respects, all the elements for forming a coaxial cable coupling according to the invention are identical with those shown in Figure 1 for forming a coaxial cable plug.

Figure 5 illustrates a modification whereby the free end (designated 2a) of the coaxial cable 2' does not have to be stepped. To achieve this, the inner conductor gripping contact element 11a within the blind bore 10a of pin 9a projects beyond the free end of the blind bore 10a. On mounting, after screwing, or pressing in of, the contacting cutting cylinder 14 a certain distance, the inner conductor gripping contact member 11a becomes supported by the inner conductor 3' of the coaxial cable 2, and penetrates between the dielectric 4' and the outer periphery of the inner conductor 3'. This modification could also be applied to the first described embodiments of the invention.

Figure 6 shows another embodiment. As illustrated it shows a plug/coupling combination without coaxial cables and not yet finally assembled.

The clamping/cutting connector 121 having an external cutting thread 17 has an internal thread 15 in its coupling region and friction-increasing regions 19, for example corrugations, on one of its outer surfaces, the Figure showing only portions of those arrangements.

The associated outer contact element 71 has an external thread 16 which corresponds with the internal thread 15 of the contacting cutting cylinder 121. In this case as in the previous ones, a contact pin 9 is provided for the inner conductor in an inner insulating body 8. The corresponding coupling element has a corresponding contact socket 9' in the insulating body 8 in a manner similar to the configuration shown in Figure 3b. Here too, external regions may be

provided with a friction-increasing corrugation 20 or alternatively with spanner-application faces, the latter not being shown separately in the Figures.

Figure 7 shows the possibility of designing the plug in such a manner that the contact pin 9 in the plug can be dispensed with, the inner conductor 3 being passed into the open space in the outer conductor contact element 71 through an appropriately adapted insulating body 81. This design of the contacting cutting element 121 corresponds to that shown in Figure 6, while the contact socket 91 receiving the inner conductor 3 in the coupling element is correspondingly adapted to the external diameter and is designed in such a manner that it is also able to receive the inner conductor of the other coaxial cable, not shown.

Figure 8 shows a design having a contact/cutting cylinder 122 that is provided with an internal cutting thread 18 for gripping the outer surface of the outer conductor of a coaxial cable, not shown. Fastening to the outer conductor contact element 71 is carried out here by means of a coupling ring 131.

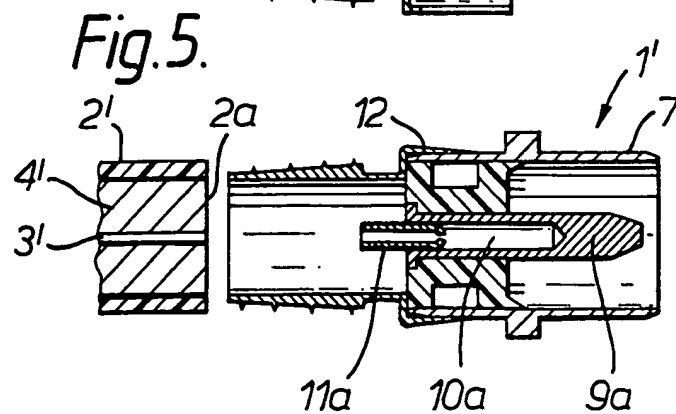
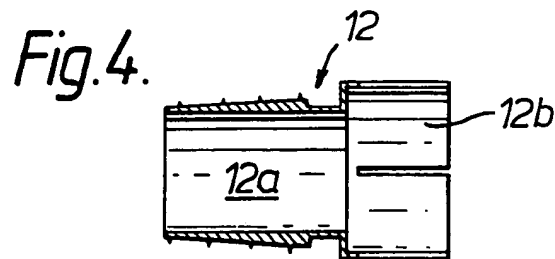
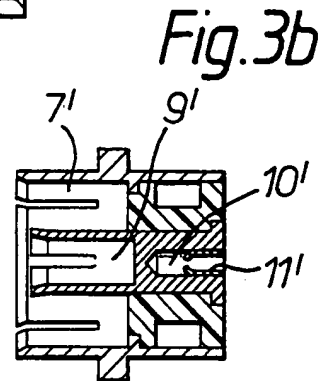
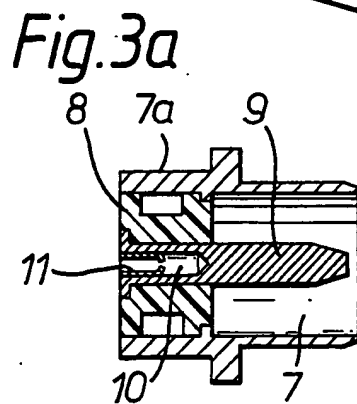
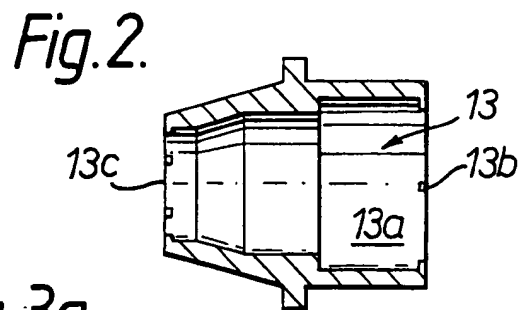
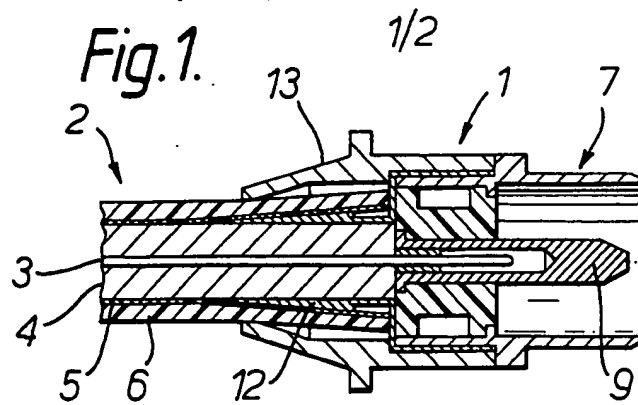
Finally, Figure 9 shows the possibility of constructing the contacting cutting cylinder 123, again provided with an internal cutting thread not shown in detail, in such a manner that it has a level rather than a wedge shaped exterior surface along its length. This is only possible if the external diameter of the coaxial cable makes it possible.

In Figures 6-9 parts identical to part described for Figures 1-5 bear the same reference numbers.

Claims

1. A device that is a coaxial cable plug, or a coaxial cable coupling comprising:
  - (a) an outer conductor contact element for providing an electrical contact for the plug or coupling from the outer conductor of a coaxial cable;
  - (b) an insulating body fixedly connected at the factory with the outer conductor contact element without the use of screw threads, the insulating body, in use, supporting the inner conductor of the coaxial cable, and/or being provided with a contact pin (in the case of a coaxial cable plug) or a contact socket (in the case of a coaxial cable coupling) provided with a contact blind bore for receiving the inner conductor of the coaxial cable; the contact pin or socket, if present, also being connected at the factory with the outer conductor contact element and the insulating body, without the use of screw threads; and
  - (c) a contacting cutting cylinder which is a separate piece from the outer conductor or contact element, but which can be positioned, in use, in electrical contact with the outer conductor contact element, the outer conductor contact element itself being positioned, in use, on the outer or inner surface of the outer conductor of the coaxial cable.
2. A device according to claim 1, wherein the contacting cutting cylinder is also connected to the outer conductor contact element without screw threads.
3. A device according to claim 1 or 2, wherein the contacting cutting cylinder is shaped and sized so that, in use, it can be positioned to grip over at least a region of the outer conductor contact element.

4. A device according to any of the preceding claims, wherein a further sleeve is provided that can be positioned, in use, over the outer conductor contact element and the contacting cutting cylinder.
5. A device according to claim 4, wherein the further sleeve is provided with catches to make a snap-in or clamping connection to the outer conductor contact element and/or the contacting cutting cylinder.
6. A device according to any preceding claim, wherein a contact pin or socket are present and the blind bore thereof, for receipt of the coaxial cable inner conductor, is provided with an additional inner conductor gripping contact member.
7. A device according to claim 6, wherein at least part of the inner conductor gripping contact member projects beyond the open receiving end of the said blind bore.
8. A device according to any preceding claim, wherein the contacting cutting cylinder and the outer conductor contact element are respectively provided with an internally threaded and an externally threaded region or the like for fastening themselves together.
9. A device according to any one of the preceding claim, wherein the contacting cutting cylinder is provided with an external cutting thread or an internal cutting thread, respectively, or the like for cutting and contacting the inner surface of the coaxial cable outer conductor or the outer surface of the coaxial cable outer conductor.
10. A device according to any one of the preceding claims, characterised in that at least regions of the outer surface of the outer conductor contact element and/or of the contacting cutting cylinder are provided with a friction-increasing surface, such as corrugations or a spanner-application face or the like.



2/2

Fig. 6.

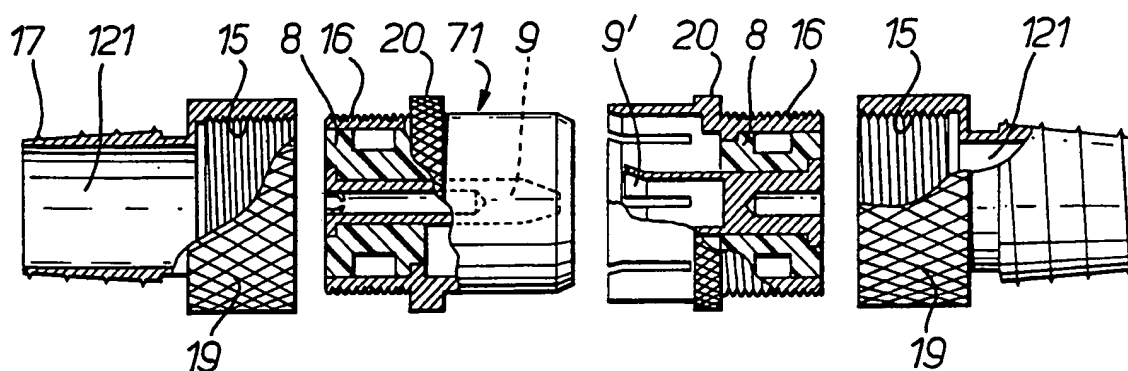


Fig. 7.

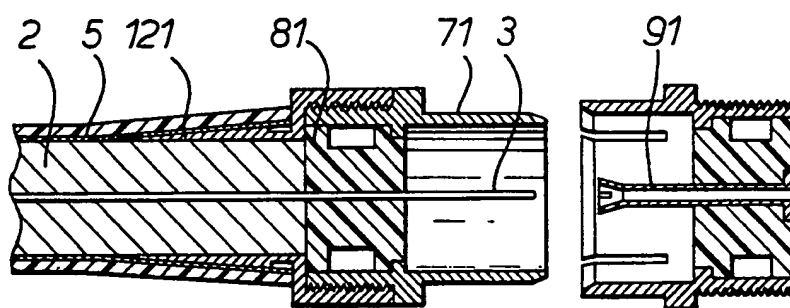


Fig. 8.

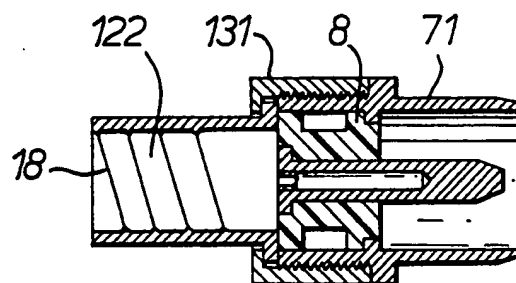
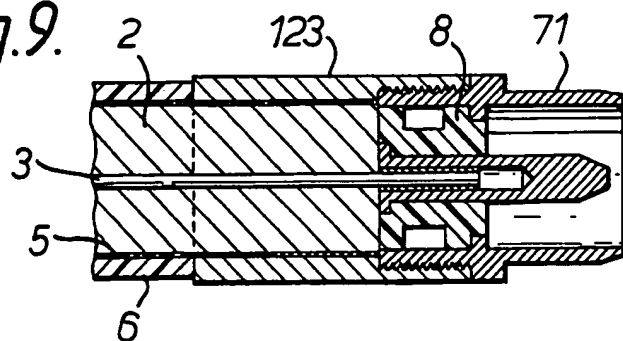


Fig. 9.





## INTERNATIONAL SEARCH REPORT

PCT/GB 92/02103

International Application No

**I. CLASSIFICATION OF SUBJECT MATTER** (if several classification symbols apply, indicate all)<sup>6</sup>

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 H01R17/12; H01R9/05

**II. FIELDS SEARCHED**Minimum Documentation Searched<sup>7</sup>

Classification System	Classification Symbols
Int.Cl. 5	H01R

Documentation Searched other than Minimum Documentation  
to the Extent that such Documents are Included in the Fields Searched<sup>8</sup>**III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>9</sup>**

Category <sup>10</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
X	US,A,3 439 294 (J.R. FLANAGAN ET AL.) 15 April 1969	1,2,3
A	see column 3, line 41 - column 5, line 18; figures 2,3 ---	6
X	US,A,3 671 922 (W.M.E. ZERLIN ET AL.) 20 June 1972	1
A	see column 2, line 18 - line 66; figure 1 ---	8,9
A	FR,A,2 204 058 (BUNKER RAMO) 17 May 1974 see page 5, line 9 - page 6, line 32; figures 1-5 ---	1
A	DE,U,7 123 952 (R. BOSCH ELEKTRONIK) 16 September 1971 cited in the application see claim 1; figures 1,2 ---	1,4
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<sup>10</sup> Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"A" document member of the same patent family

**IV. CERTIFICATION**

Date of the Actual Completion of the International Search

28 JANUARY 1993

Date of Mailing of this International Search Report

12.02.93

International Searching Authority

EUROPEAN PATENT OFFICE

Signature of Authorized Officer

LOMMEL A.

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	WO,A,9 015 454 (RAYCHEM) 13 December 1990 cited in the application see abstract; figures 1-6 -----	1,4

# ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on  
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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